

## ***Unifrost NV/SA and Air Products***

**Our work together**



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Bart Oliver, Technical Manager, Unifrost, Koolskamp, Belgium.





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PRISM® Membrane System





*Companies who use automated warehouses for cold-storage may soon face a new safety requirement: the use of nitrogen to reduce fire risks. That's what happened to Unifrost NV/SA, a leading Belgian producer of frozen vegetables. Unifrost found an economical and reliable source of nitrogen in the Air Products PRISM<sup>®</sup> nitrogen generator.*



Frozen vegetables may sound an unlikely fire hazard, but Belgian frozen food producer Unifrost takes the issue seriously at its state-of-the-art 200,000m<sup>3</sup> automated warehouse. Though the vegetables themselves are not very flammable, packaging and pallets certainly are, along with the polyurethane foam used to insulate the warehouse walls and maintain the temperature at -22°C.

Should a fire take hold, the layout of an automated warehouse makes fire-fighting difficult: “Underneath the insulation there is not really a building,” explains Bart Ollivier, Unifrost’s Technical Manager. “There is just a steel frame, nearly 30m high, that’s designed for automated vehicles, not people.”

*This is the compressor that drives the Membrane System*



In the oil and chemical sector, reduced-oxygen atmospheres have for many years been a common method of reducing fire risks. Now fire safety authorities and insurers are encouraging other sectors to consider using reduced-oxygen atmospheres. As a result, companies who use automated warehouses – and not just in the frozen food sector – are turning to Air Products for advice.



*Unifrost warehouse*

The idea is simple: fires need oxygen to burn, so they can be slowed or prevented by lowering the oxygen level of the atmosphere inside the warehouse. Ordinary air containing 21% oxygen creates the fire hazards with which most people are familiar. If the level of oxygen is reduced to 17%, however, fires become hard to start, and tend to smoulder without spreading. Reducing oxygen levels to 10–12% most materials will not burn at all.

Although the Unifrost warehouse is automated, day-to-day operations do require manual intervention. This is mainly because pallets and boxes shrink slightly during storage and the resulting loss of balance can derail them from the automated system. To allow people to work safely in the reduced-oxygen atmosphere, a number of layers of protection – operational, design and medical – are required.

Reducing the oxygen level means replacing some of the oxygen with another gas that is non-flammable, non-toxic and preferably cheap. The obvious choice is nitrogen, and Unifrost opted for an Air Products *PRISM*<sup>®</sup> membrane nitrogen generator with an associated oxygen monitoring and control system. The complete system is compact, reliable and economical.

“Apart from lower insurance premiums, there’s not a great deal of payback from using nitrogen,” admits Bart Ollivier. “But Unifrost and our parent company, Dujardin Foods, are committed to best practices in health, safety and environmental protection, and the use of nitrogen follows from this. We’re very pleased with both the nitrogen generator and the service we have received from Air Products.”

## Hall of plenty

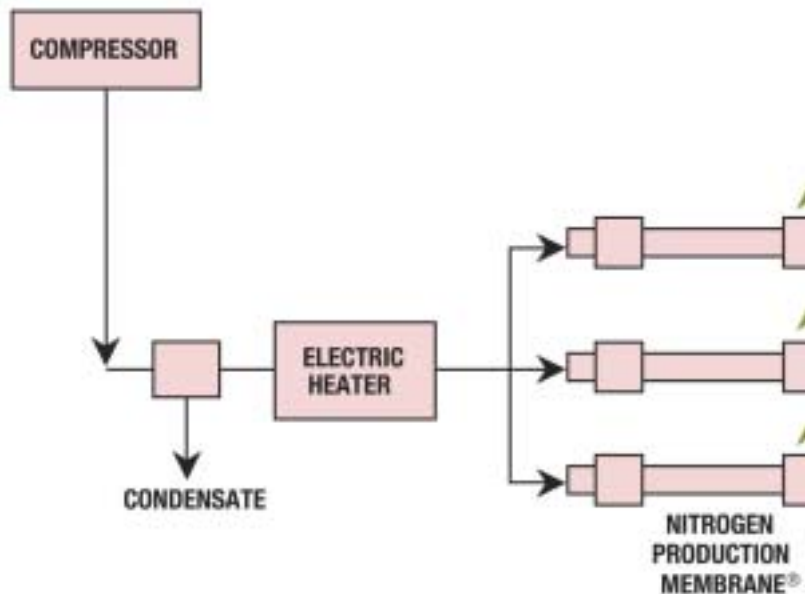
Unifrost produces a wide range of frozen vegetables, mostly under supermarket labels. The company was founded in 1974, when frozen vegetables were still a novelty for many consumers in continental Europe. The factory, 15 miles south of Bruges, occupied 3,000 m<sup>2</sup> and employed just 15 people to produce 1,500t/y of frozen vegetables.

As tastes have changed, the factory has expanded. In 1990 Unifrost began an ambitious investment programme covering the whole site, which now occupies 100,000m<sup>2</sup> and employs 300 people. Four freezing lines and 11 packaging lines turn out more than 800 individual product types. 70,000t/y of vegetables frozen on site are supplemented with produce frozen elsewhere, yielding a total output of around 110,000t/y.

A big part of the investment is the new automated warehouse for storing packaged frozen foods. Completed in 2000, the warehouse measures 130m long, 55m wide and 28m high. It can hold 36,800 euro-pallets, or around 26,000 pallets in mixed sizes.

The state-of-the-art warehouse has ten levels, each containing pallets stacked up to six deep and serviced by up one or two automated vehicles. There are five

*Typical process flow diagram for PRISM® Membrane system*





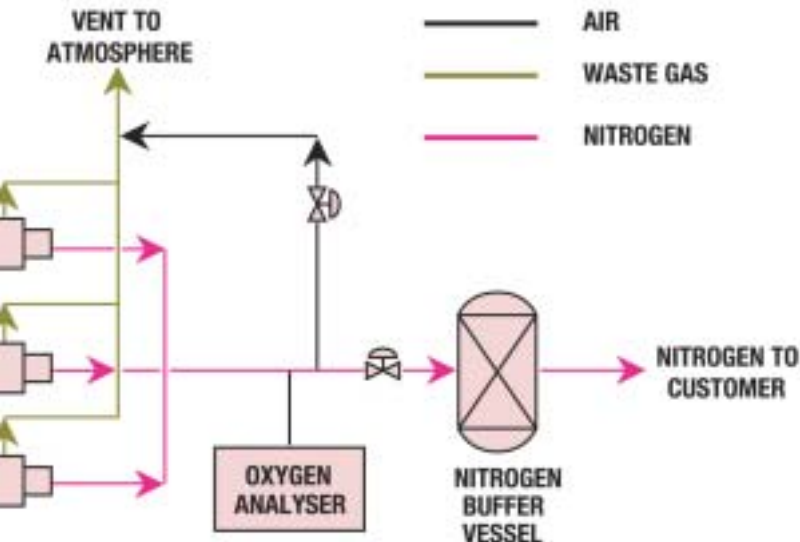
elevators: two each for goods entering and leaving the warehouse, and one for the vehicles. The warehouse handles up to 2,000 stock movements every day, and is completely unattended except for maintenance.

A mechanical refrigeration system with air circulation fans keeps the warehouse temperature at a steady  $-22^{\circ}\text{C}$ . Heat leakage is minimised by 200 mm of foam insulation, sandwiched between steel panels, and by airlocks on the doors.

While construction was still under way, Unifrost decided to equip the warehouse with a nitrogen system to allow it to work at reduced oxygen levels. The company approached Air Products and another industrial gas supplier for advice and quotations.

“We already had a good working relationship with Air Products,” notes Bart Ollivier. Unifrost, he explains, has for several years bought Air Products liquid nitrogen for one of its freezing lines, and liquid oxygen for the Air Products OXY-DEP™ biological treatment process installed at the site’s wastewater plant.

Following the tradition of this successful relationship, Air Products staff spent a good deal of time working with Unifrost to ensure that the nitrogen generator would do its job effectively. Yet any proposal, however good technically, must also be affordable,





*Inside of a PRISM® Membrane system*

and the final decision to go with Air Products was made on price, says Bart Ollivier.

## Measuring up

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Air Products and Unifrost worked together to calculate the size of nitrogen generator they would need, based on a nominal oxygen level of 17% in the warehouse atmosphere.

Since the plan was to maintain the reduced-oxygen atmosphere permanently, the



time needed to reach the working oxygen level was not critical. Instead, the nitrogen demand would depend mainly on the amount of gas lost through leakage.

Detailed estimates of the number of stock movements daily, and the amount of gas lost each time the warehouse doors are opened, allowed Air Products to calculate the amount of nitrogen needed to make up the losses.

The amount of nitrogen required would not have been economic to generate by evaporating liquid nitrogen, especially since high purity is not needed. Instead, the duty is perfect for a nitrogen generator that uses a semi-permeable membrane to

separate nitrogen from atmospheric air. Air Products proposed a *PRISM*<sup>®</sup> G5000 generator. This self-contained unit measures just 3.5m x 1m x 2m (l x d x h), and needs only three connections: electricity, compressed air and a drain. The compressor measures another 2.4m x 1.7m x 1.9m (l x d x h) and requires a separate electrical connection.

Because the warehouse is so large, if the nitrogen generator were to stop working it would take several days for the oxygen concentration to approach atmospheric levels. As *PRISM*<sup>®</sup> generators are reliable and need little maintenance, Unifrost decided not to install a backup nitrogen system. "Air Products has plenty of time to fix it, in the unlikely event that anything should go wrong!" says Bart Ollivier.



Control panel



Analyser



As part of the proposal Air Products defined the requirements for the control system, including oxygen sensors, to ensure that the required oxygen level is maintained throughout the warehouse atmosphere. The control system also monitors the integrity of the nitrogen generator, and if a fault is found it switches off the generator and raises an alarm in the control room. There are options for continuous logging of oxygen levels and remote monitoring of system functions through Unifrost's own control system.

The control system also monitors the

atmosphere in the ancillary rooms next to the warehouse. If the oxygen concentration here falls to a potentially dangerous level, the system switches off the nitrogen generator and raises alarms so that people can be evacuated if necessary.

## Safety and reduced-oxygen atmospheres

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Historically, the industrial gas industry has been very concerned about reduced-oxygen atmospheres as asphyxiation has been recognised as one of the more common causes of death.

Air Products is a signatory to the American Compressed Gas Association guidance on safety in reduced-oxygen atmosphere, which states that atmospheres containing less than 19.5% oxygen must be treated as hazardous.



The European Industrial Gas Association's Document 44/00 states: "Any depletion of oxygen below 21% must be treated with concern. The situation is hazardous as soon as the oxygen concentration is less than 18%".

At Unifrost the intention was to operate permanently at 17% oxygen, with limited manual intervention. This situation required a different approach from the one normally used by industrial gas companies. Air Products therefore performed a safety study that led to stringent design, operational and medical requirements, which in turn provided Unifrost with several levels of protection. Although these had commercial consequences, Unifrost supported its legal obligation to provide a safe place of work.

## Going ahead

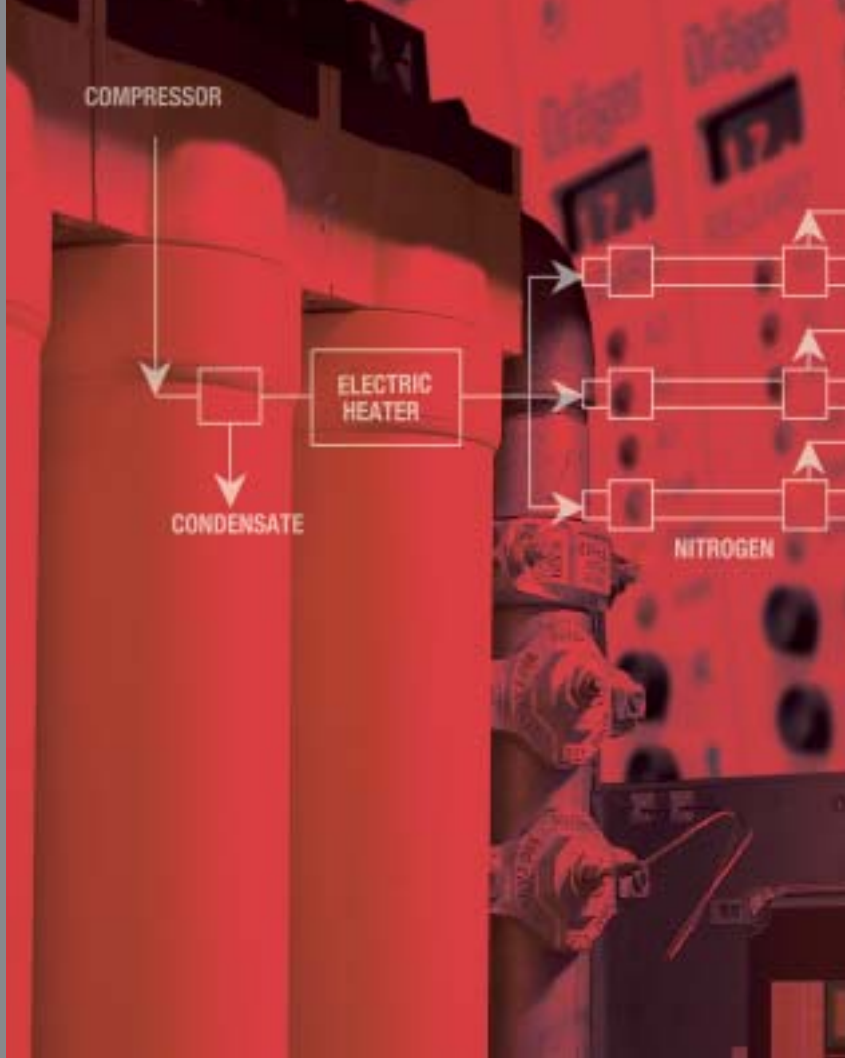
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Happy with the overall commercial proposal, Unifrost signed a long-term rental contract with Air Products for the *PRISM*<sup>®</sup> unit. The contract contains a considerable amount of detail to ensure that it meets the requirements of both parties, but in essence it guarantees that Unifrost will not be penalised for any periods when the generator is inoperable. Air Products is responsible for monitoring the generator performance - by telemetry - from a local Air Products engineering centre, and maintaining the installation.

The nitrogen system was installed in 2001, though full commissioning was delayed until October 2002 because of teething problems with the automated pallet-moving machinery. Now the system is up and running, Bart Ollivier says he is pleased with its performance. After switch-on the oxygen level fell from 21% to 19% in three days, and to 17% in another three days.

"So far, we're very pleased with the system," says Bart Ollivier. "It was installed with very little fuss, and it does the job it was designed to do. What more could we ask for?"





## tell me more

[www.airproducts.com/prism](http://www.airproducts.com/prism)

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